ALPHITOBIUS DIAPERINUS (COLEOPTERA: TENEBRIONIDAE) LARVA AND ADULT MOUTHPARTS[1,2,3]

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ABSTRACT: *Alphitobius diaperinus* adult and larval mouthparts are studied and described. Based on mandibular structure, adults are considered general feeders whereas larvae possess planar molar surfaces that are an adaptation for feeding on "cemented" food substances.

Alphitobius diaperinus (Panzer), commonly known as the lesser mealworm, darkling beetle or litter beetle by the poultry industry, is often sufficiently abundant in poultry houses to cause economic damage. Initially this species was known as a stored product pest, but it is now considered a structural pest of poultry house insulation (Vaughan *et al.*, 1984; Despins *et al.*, 1987). Damage occurs when prepupae burrow into insulation to pupate and additional damage is caused by emerging adults and by adults that follow the prepupae into the burrows. (Vaughan *et al.*, 1984).

The original range of *A. diaperinus* was eastern Africa where it occurs naturally in nests of birds and in bat guano (Vaughan *et al.*, 1984). McFarlane (1971) indicated that *A. diaperinus* feeds on detrital fragments found on the cave floors and in guano litter. When associated with poultry, *A. diaperinus* may feed on damp, mouldy grain, poultry carcasses and feces (Lewis, 1958; Back and Cotton, 1962; Lancaster and Simco, 1967). Pfieffer and Axtell (1980) consider *A. diaperinus* the best-adapted scavenger of poultry houses.

In this paper we describe *A. diaperinus* adult and larval mouthparts and, based on these descriptions, hypothesize as to their feeding habits.

METHODS AND MATERIALS

The heads of laboratory-reared *A. diaperinus* were removed and treated in hot 10% KOH, placed in glycerin and then dissected. Mouthparts were removed and rinsed in 70% alcohol, air dried and prepared for scanning electron microscopy (SEM). Additional structures were slide

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mounted in CMC (1-Cyclohexyl-3-(2-morpholinoethyl) carbodiimide metho-p-toluenesulfonate) media. Terminology for mouthparts follows Watt (1974) and Doyen and Tschinkel (1982).

DESCRIPTIONS

Adult mouthparts. Mandibles symmetrical, each with a pair of apical incisor teeth, the dorsal tooth continuous with an incising surface extending to the middle of the mandible proper (Fig. 1E). A basal flat hyaline retinaculum is attached ventrally with a frayed mesal surface. Surrounding the retinaculum is a broad channel formed by the ventral apical tooth and outside continuity. Basally, a small ental planar mola with a vertical mesal face and an ectal area of small hairs is located above the condyle. The epipharynx, labium and maxilla are typical for Tenebrionidae.

Larva mouthparts. Mandibles asymmetrical, each with a pair of incisor teeth, the ventral tooth subapical (Fig. 1A). Left mandible with a mesal dorsal process that fits over the corresponding medial process of the right mandible. Left mandible also with a basal planar mola. Right mandible with a well-developed medial planar concave mola that fits onto the corresponding left mola (Fig. 1A,D). Epipharynx and labium typical for Tenebrionidae. Hypopharyngeal sclerite anteriorly concave (Fig. 1B). Lacinea lacking an uncus and bearing bristles (Fig. 1B).

DISCUSSION

Mandibles of adults are typical for Tenebrionini (Doyen and Tschinkel, 1982). The incisors are used for removal of food, and the dorsal incisor surface is used for scraping (Fig. 1-E). The frayed retinaculum may be used to move the food towards the molae for compaction. The mandible itself is unspecialized and is indicative of a general feeding habit.

Mandibles of larvae are massive and adapted for both shearing and compacting. Under poultry house conditions the apical incisors appear capable of removing "cemented" (large pieces of food in a matrix of smaller pieces bonded together by a natural cement, similar to concrete) food particles of poultry pellets (feed), fecal material and poultry house insulation material. The bolus is channeled posteriorly to the fossa produced by the combined ventral areas of the mandibles and by the bristled lacineae, while the assymetrical molae compact the bolus. The function of the hypopharygeal sclerome is enigmatic, but it may facilitate movement of the bolus into the mouth.

Doyen and Tschinkel (1982) considered the planar mola to be plesiomorphic in contrast to an apomorphic, specialized, striate mola. Their philosophy is based on the widespread occurrence of the plesiomorph in Heteromera and primitive tenebrionid taxa. Watt (1974) considered the striate mola to be apomorphic in larvae but plesiomorphic for adults.

Striate molar surfaces are often associated with pollen, fungus and fungus spore and wood feeding (Doyen and Tschinkel, 1982; Lawrence, 1988). No function has been proposed for the planar molar condition except for *Platydema ellipticum* (Fab.) (Diaperinae), which has a similar larval morphology to *Alphitobius* but feeds exclusively on hard bracket fungi (Lawrence, 1988).

Thus, the mouthparts of larval *Alphitobius* are adapted to feeding on material that has been organically cemented together and merely needs to be raked and compacted without trituration. Since trituration is minimized, no striate surfaces are required on the molae. Materials that are less dense

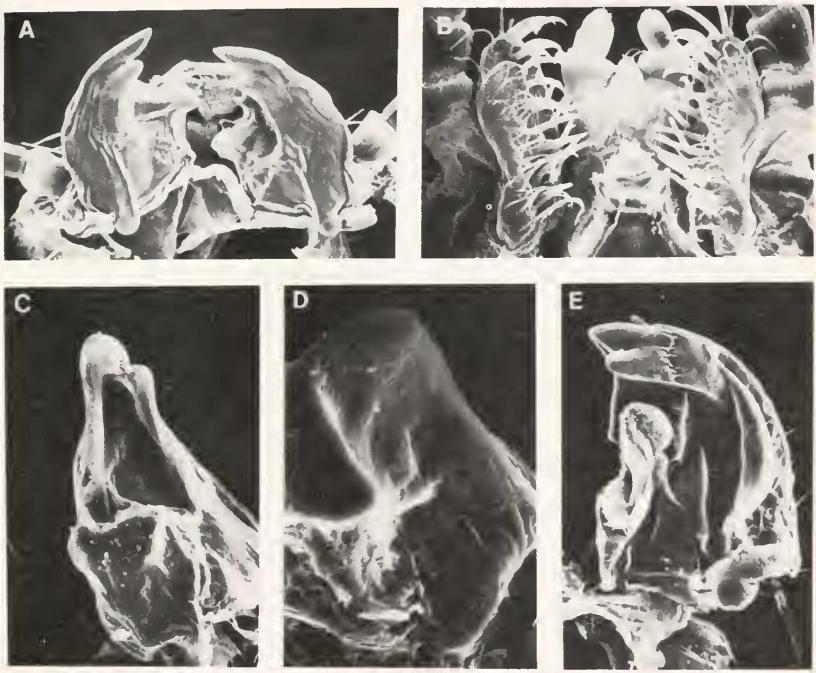

Figure 1. SEM photomicrographs of *Alphitobius diaperinus* (Panzer) mouthparts. A. Ventral aspect of larval assymetrical mandibles. B. Dorsal aspect of larval maxilla, labium and hypopharyngeal sclerome. C. Inner aspect of left mandible of larva. D. Larval right mandibulur mola showing concave planar surface. E. Adult left mandible (retinaculum shriveled due to chemical treatment).

and loosely packed may also be consumed. Vaughan et al. (1984) showed that *A. diaperinus* responds differently to insulation types. They found that polyestyrene was preferred by late instar larvae for pupation sites over polyurethane and fiberglass. Control measures should employ mechanical barriers that do not mimic textures of its natural food items.

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